

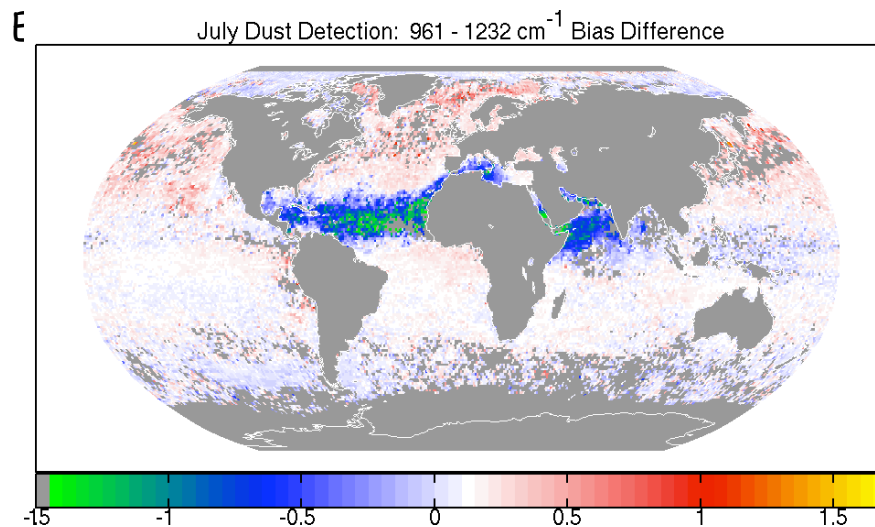
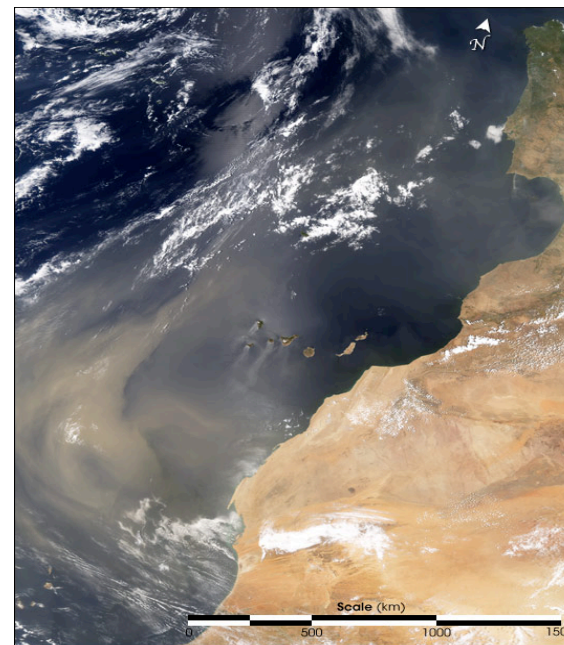
Retrieval of Dust Optical Depths

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AIRS sensitive to mineral dust, evident over large geographic areas.

Can we reliably retrieve dust optical depths and determine dust infrared forcing?

Do dust signals exist in cloud-cleared radiances?
And, if they do, can we remove the dust signals prior to the standard retrievals?



Have extensively studied Oct. 2002 dust storm over Mediterranean.
Scenes largely clear.

Use our fast scattering RTA to fit radiances.

14 channels in the 9-12 μm window used, weighting χ^2 equally
between absolute differences (obs-calcs) and split window
differences relative to 1231 cm^{-1} channel.

Cloud top and bottom fixed at nominal values eg (850,900), (700,800)
mb; optimum fit at (700,800 mb). (Most problematic parameter.)

Cloud optical depth varied in the fit.

Particle size fixed at nominal size (1.5-2.5 μm in diameter). Fits
return $\sim 1 \mu\text{m}$ particle sizes, but fixing the particle size made the
optical depth retrievals more spatially uniform.

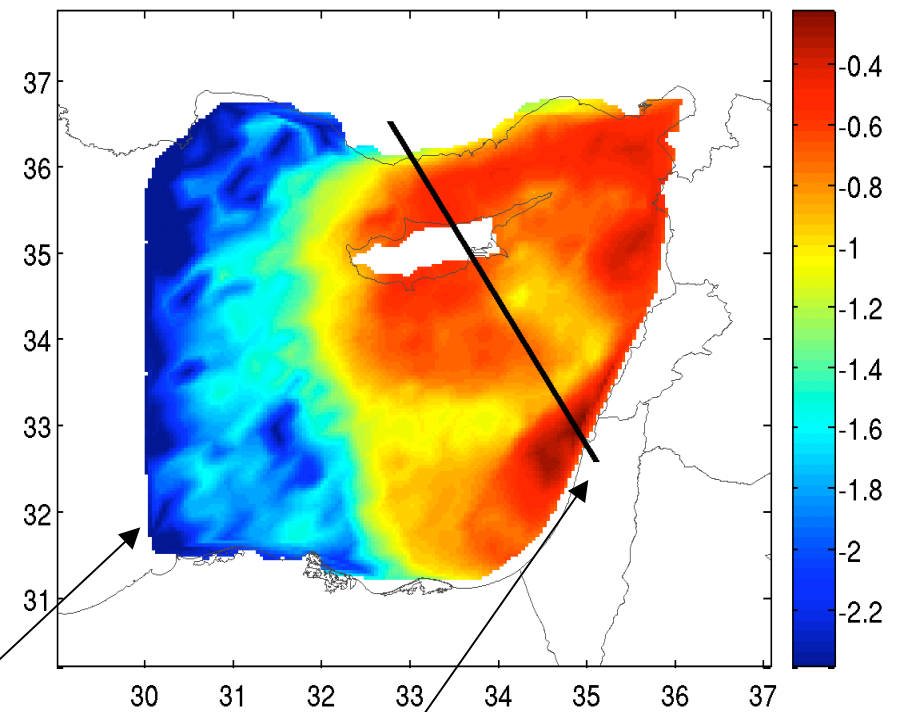
Using Volz refractive index with log normal distribution of particle
sizes.

AIRS Visible vs IR Optical Depth Retrieval

AIRS Visible Image



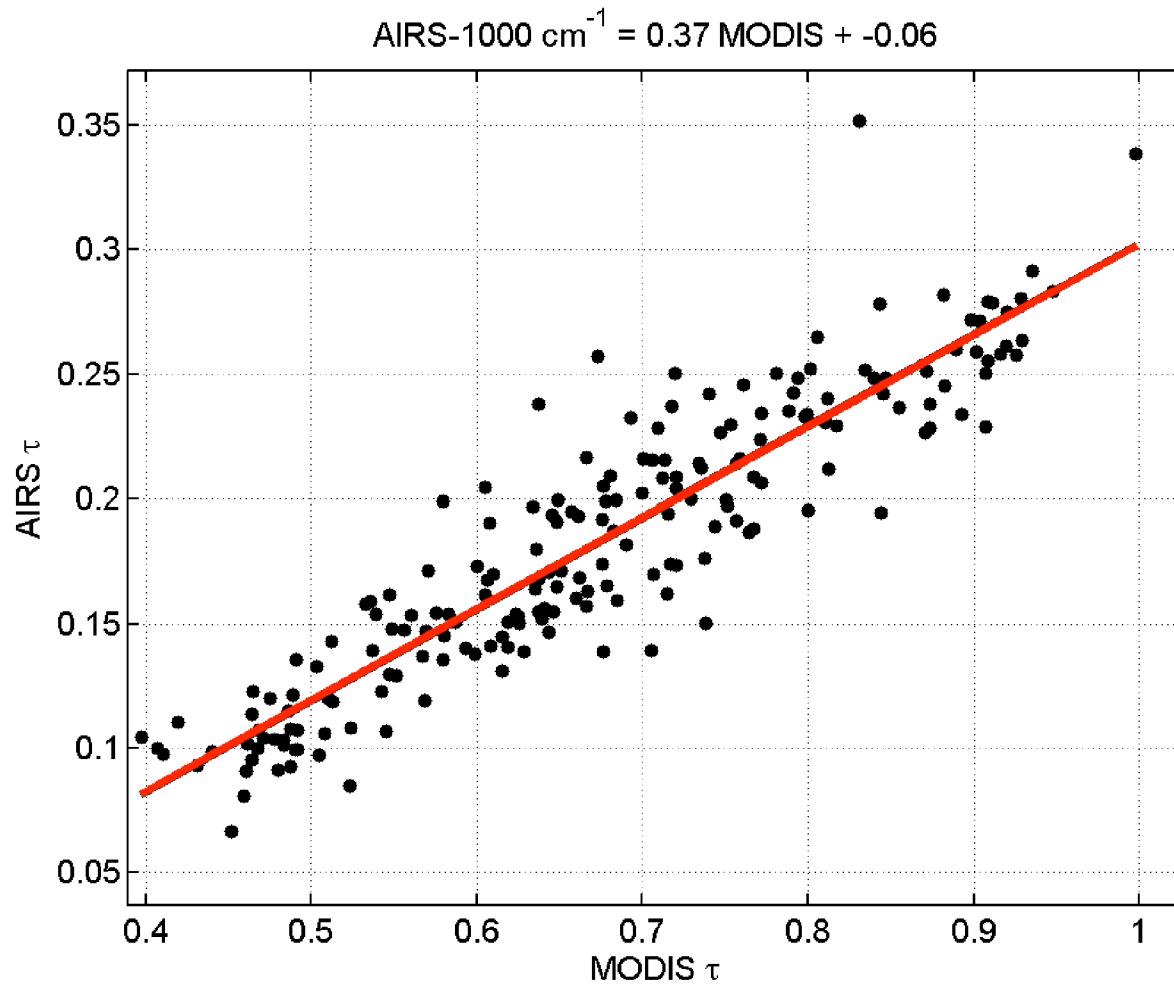
Log₁₀ of Retrieved Optical Depths



Note smooth transition to τ 's < 0.01 .

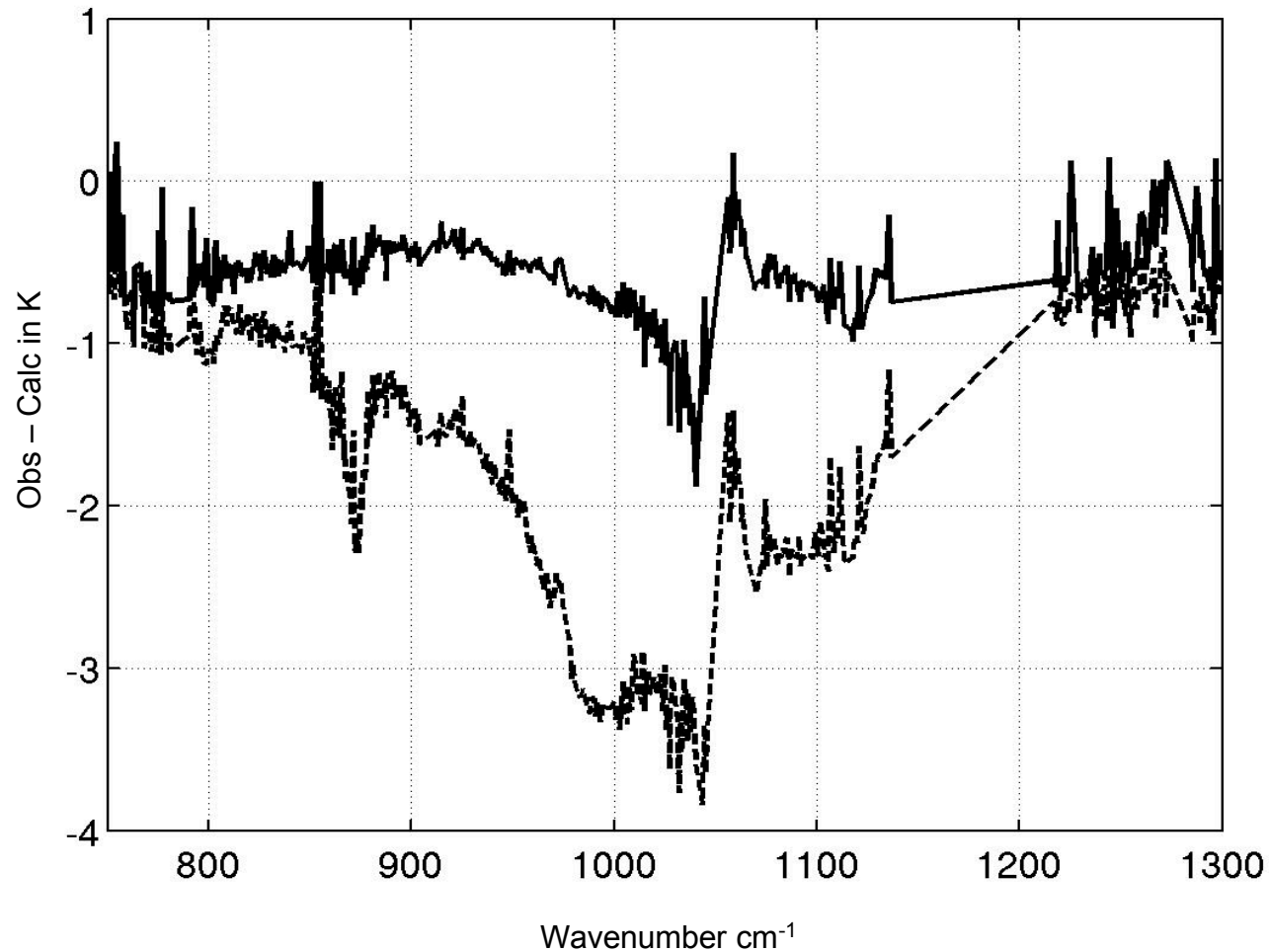
MODIS only available to upper right of this line

AIRS vs MODIS Dust Optical Depths



Cloud top/bottom = 700/800 mb, particle diam = 1.5 μm

Ability of RTA to Fit Dust Residuals



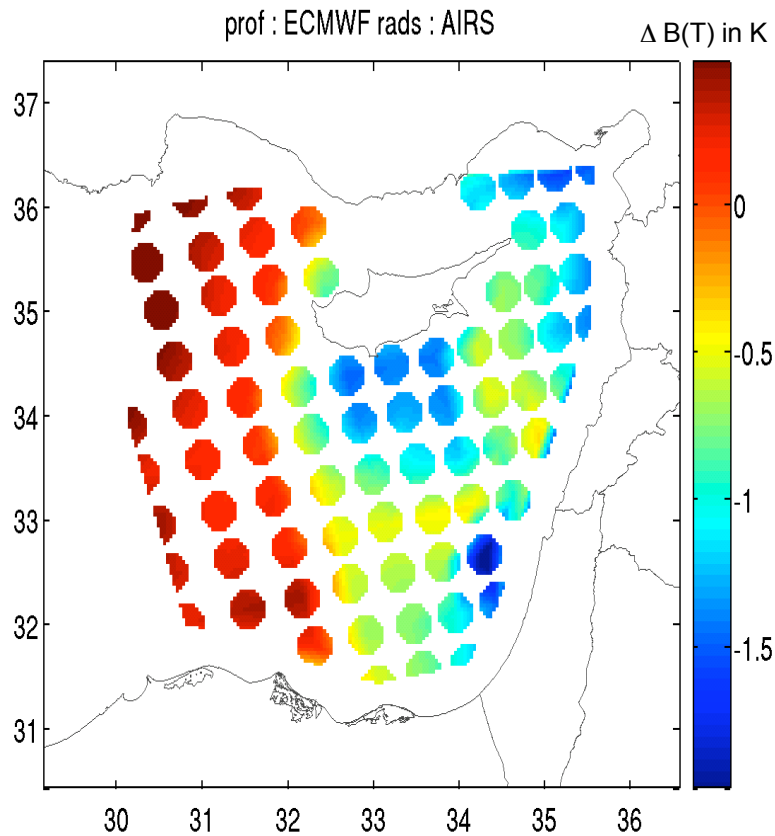
Biases for optical depths between 0.2 and 0.5 shown above.

V-shaped depression at 870 cm^{-1} not discernable in Saharan dust.

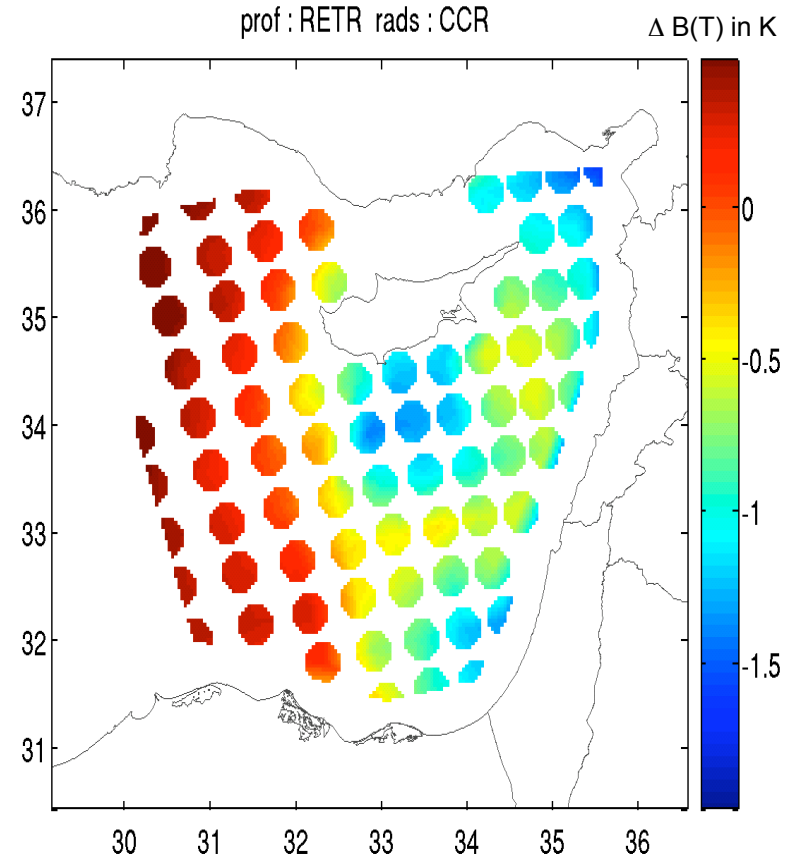
Dust and Cloud-Clearing

- Will dust aerosols survive cloud-clearing?
 - Nominally YES, for the two cases studied so far
- Can we remove the effects of dust on the cloud-cleared radiances?
 - Looks promising
 - If ignored, retrieval puts dust information into emissivity, maybe water profile, etc.
- Appears that some cloud signatures also survive cloud-clearing - very preliminary, not sure reading all flags properly.
- Examine both Mediterranean and African cases here.

L1b: every 9th FOV

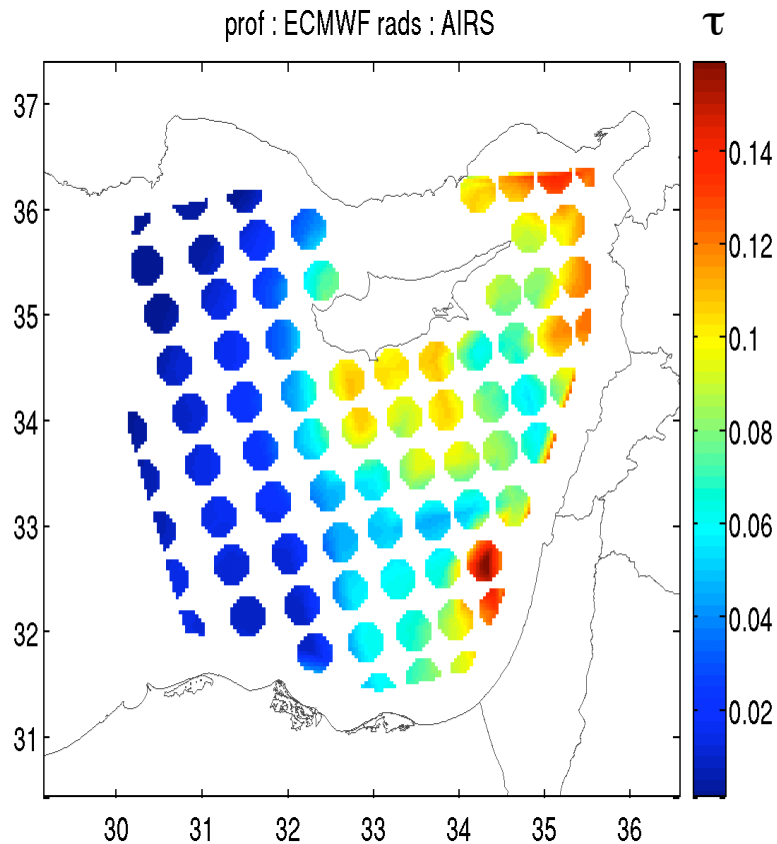


Cloud-cleared data

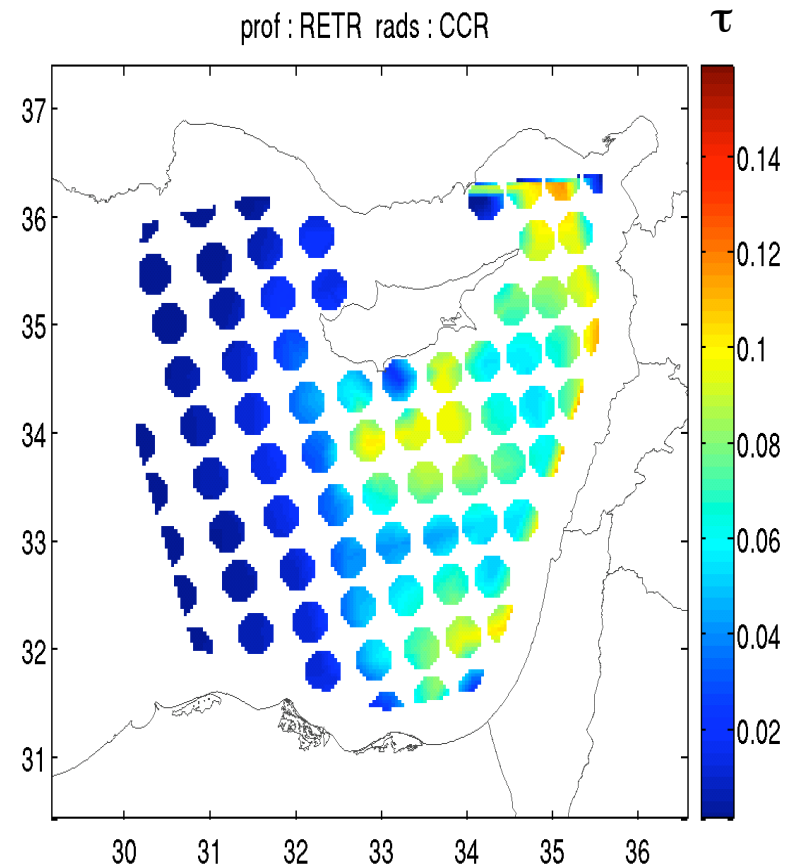


Dust Optical Depths from L1b vs Cloud-Cleared Radiances

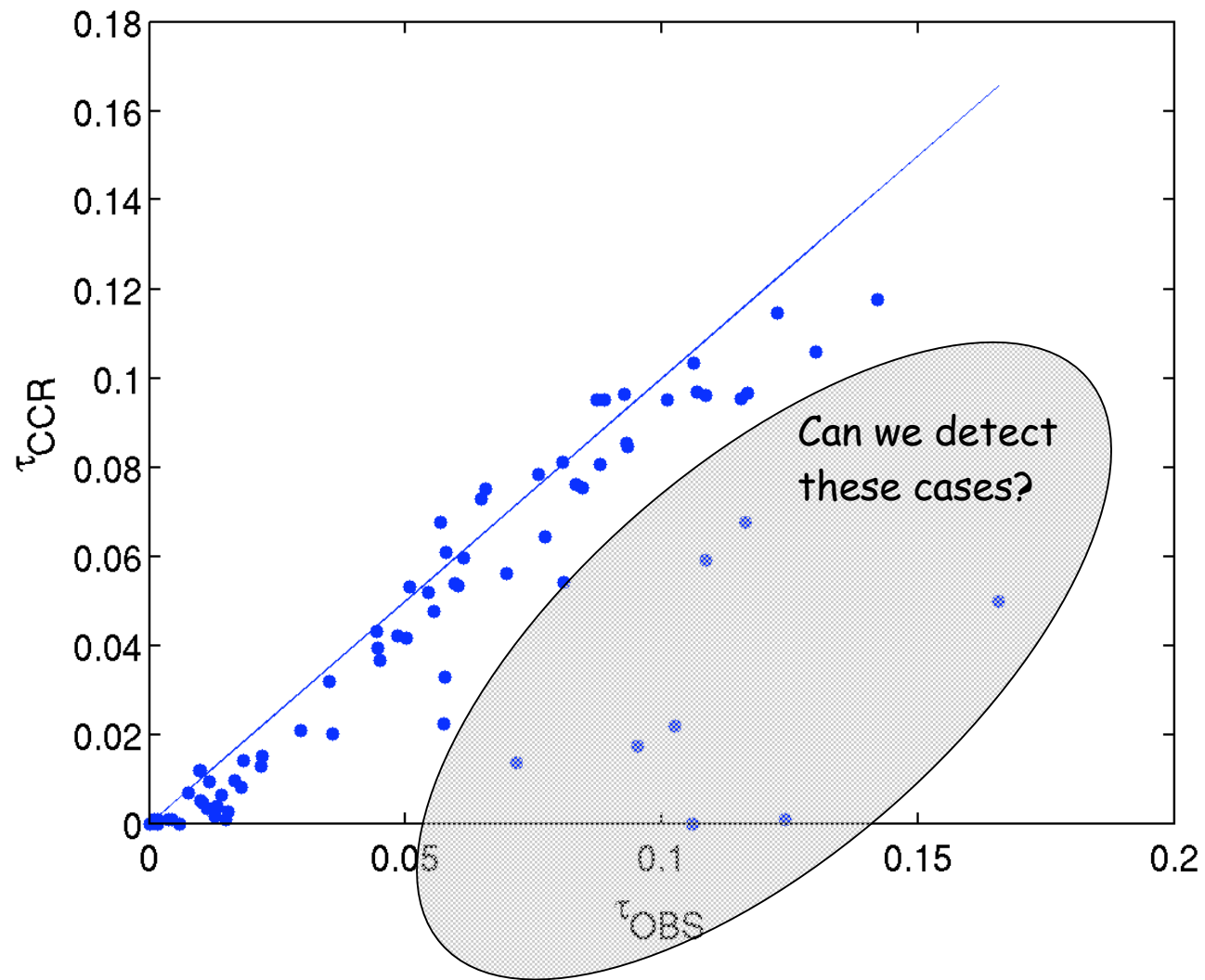
L1b: every 9th FOV

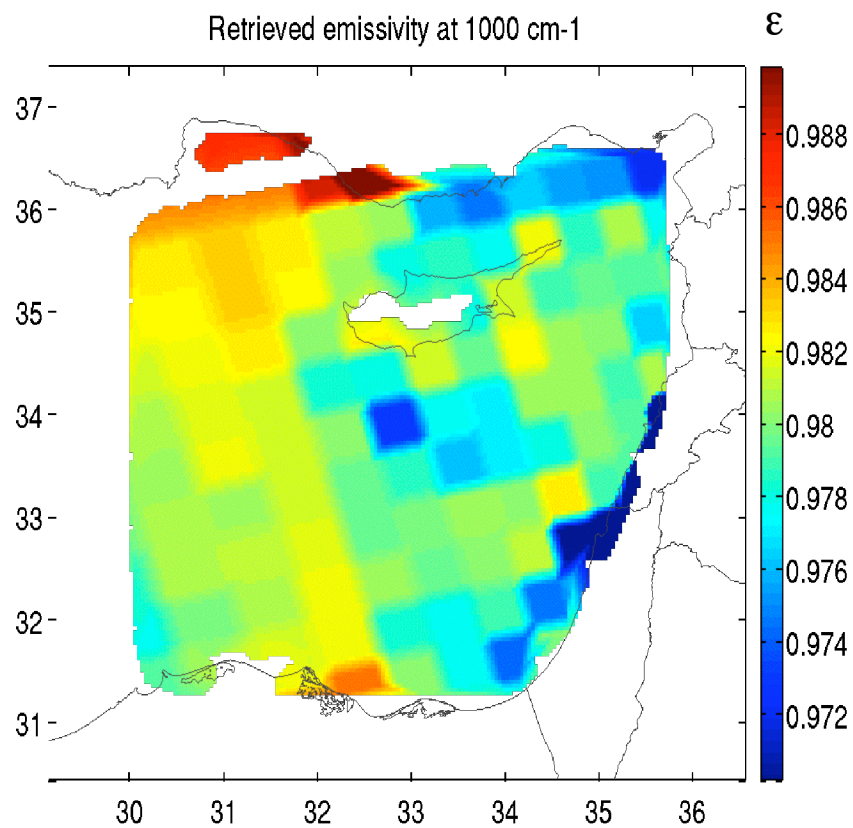
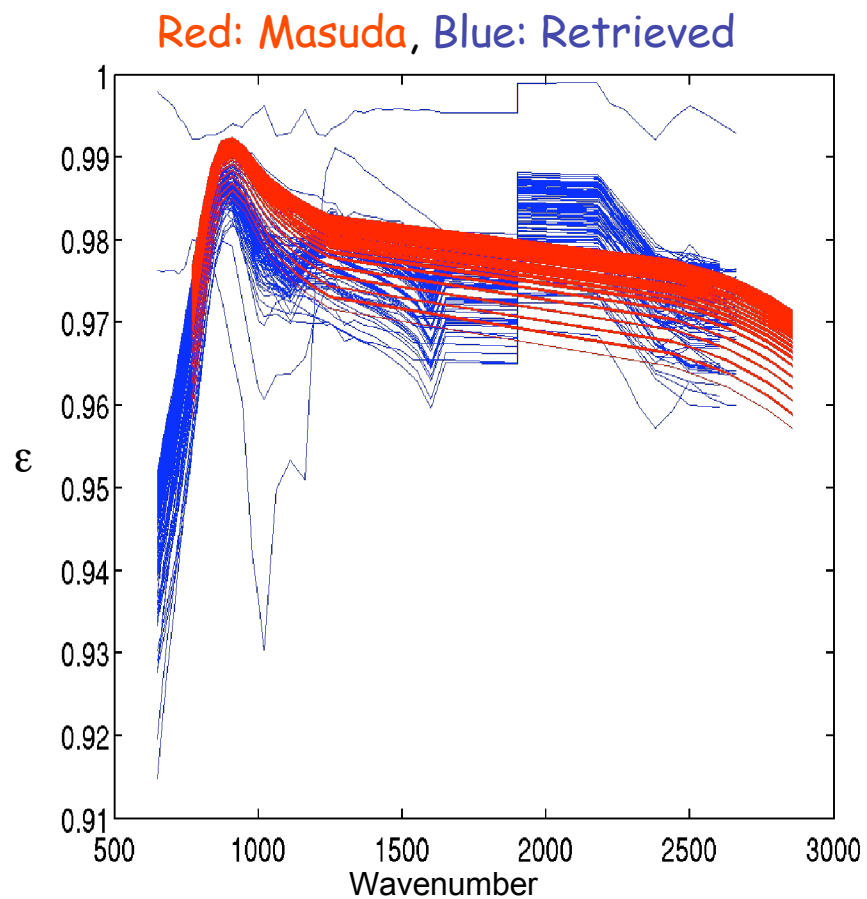


Cloud-cleared data

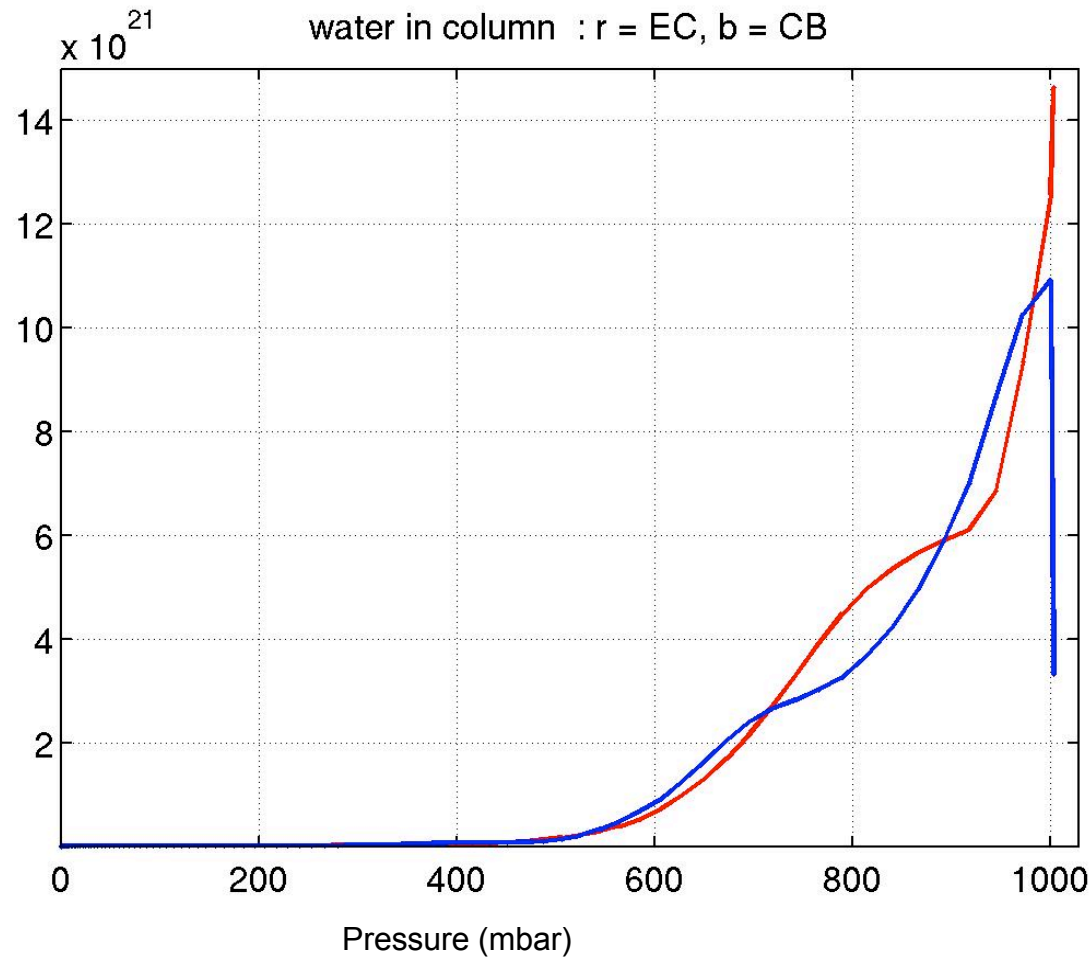


Cloud-Cleared vs L1B Optical Depths





Retrieved Water (prelim.)

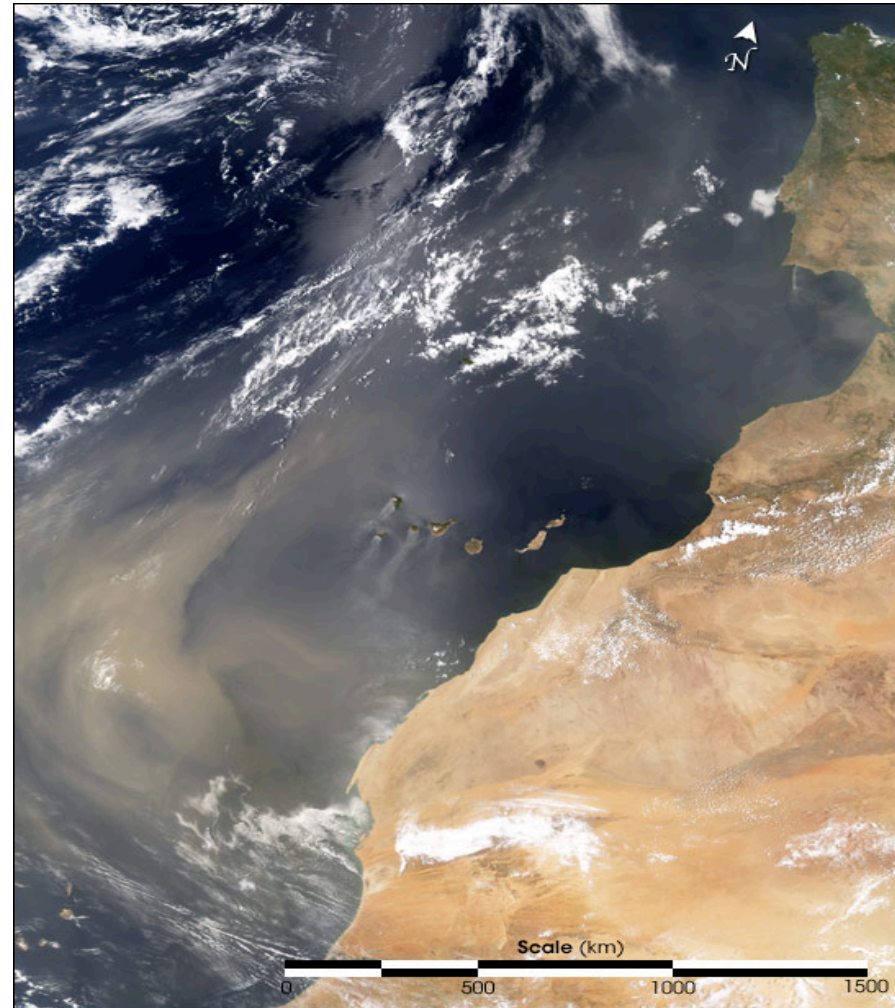


Average over the profiles in the dust-storm region
Explanation could be "fractional" lowest layer?

More complicated situation:
scattered clouds.

Very preliminary results.

Attempted both dust and cloud
optical depth retrievals.

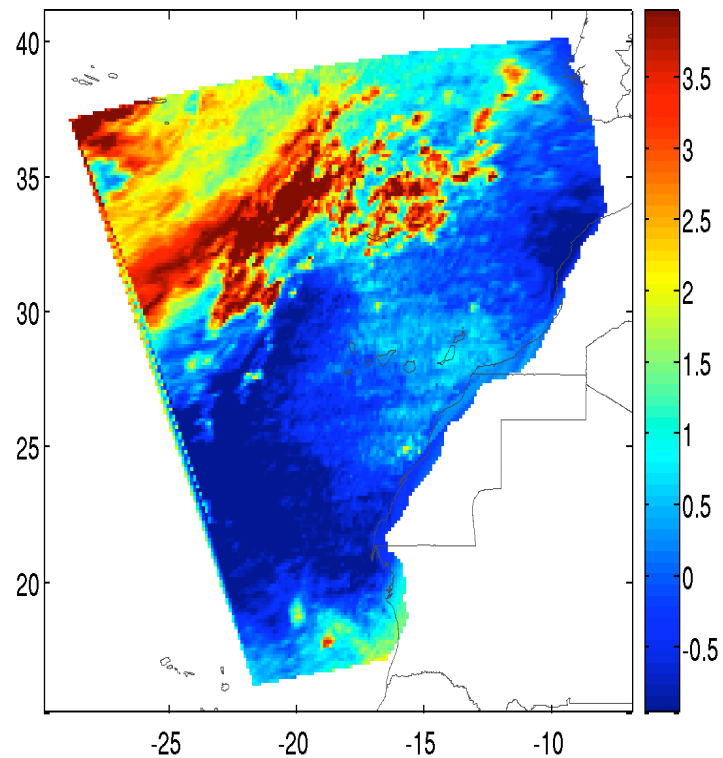


Saharan Dust Storm

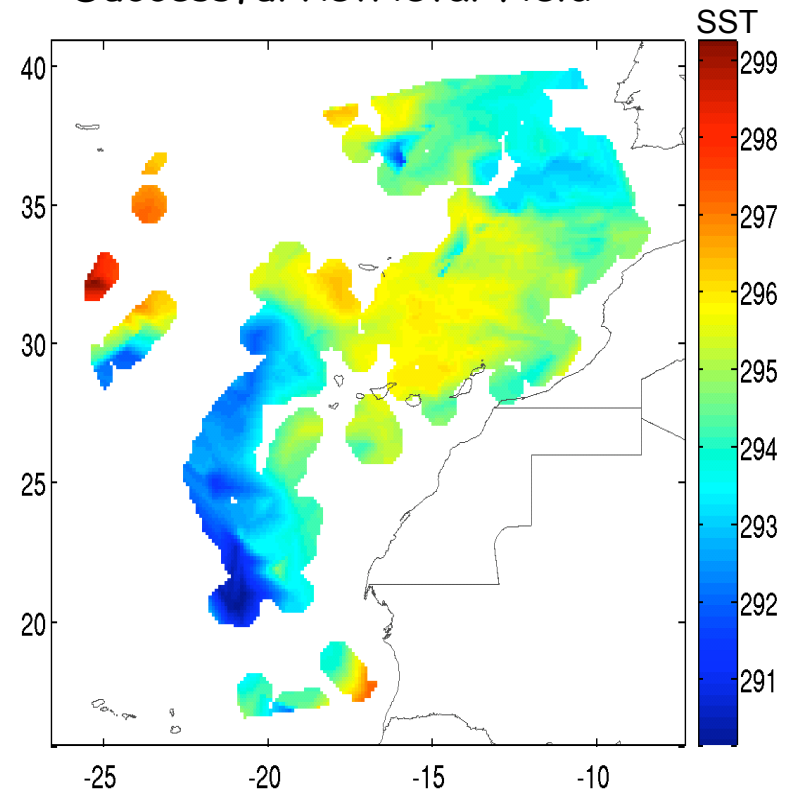
L1b B(T)'s

BT 951 - BT 805

$\Delta B(T)$ in K

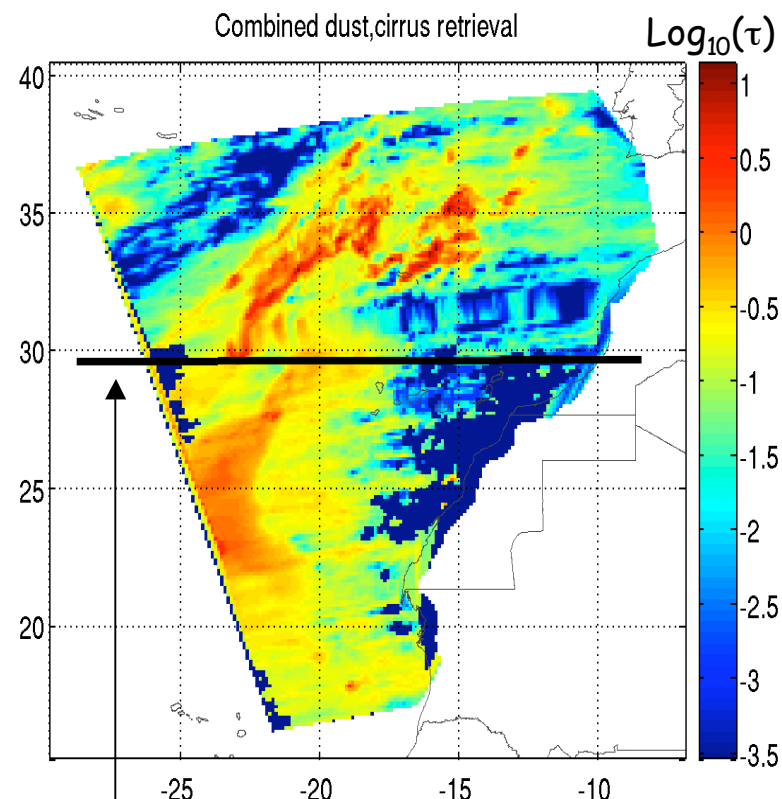
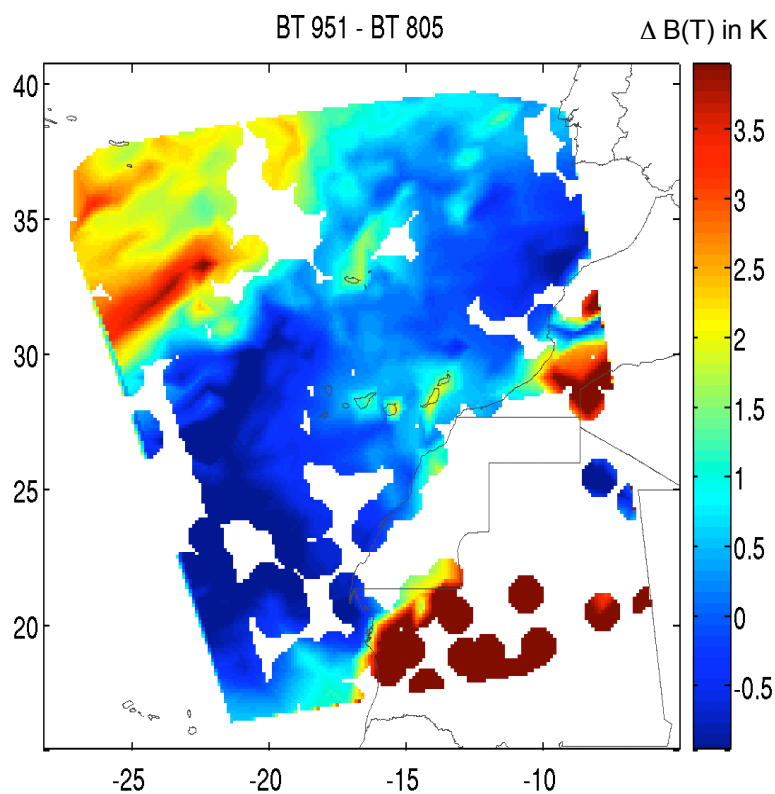


Successful Retrieval Yield



BT951-BT805 shows dust (blue) and cirrus (red)
Far fewer center FOVs made it thru the retrieval

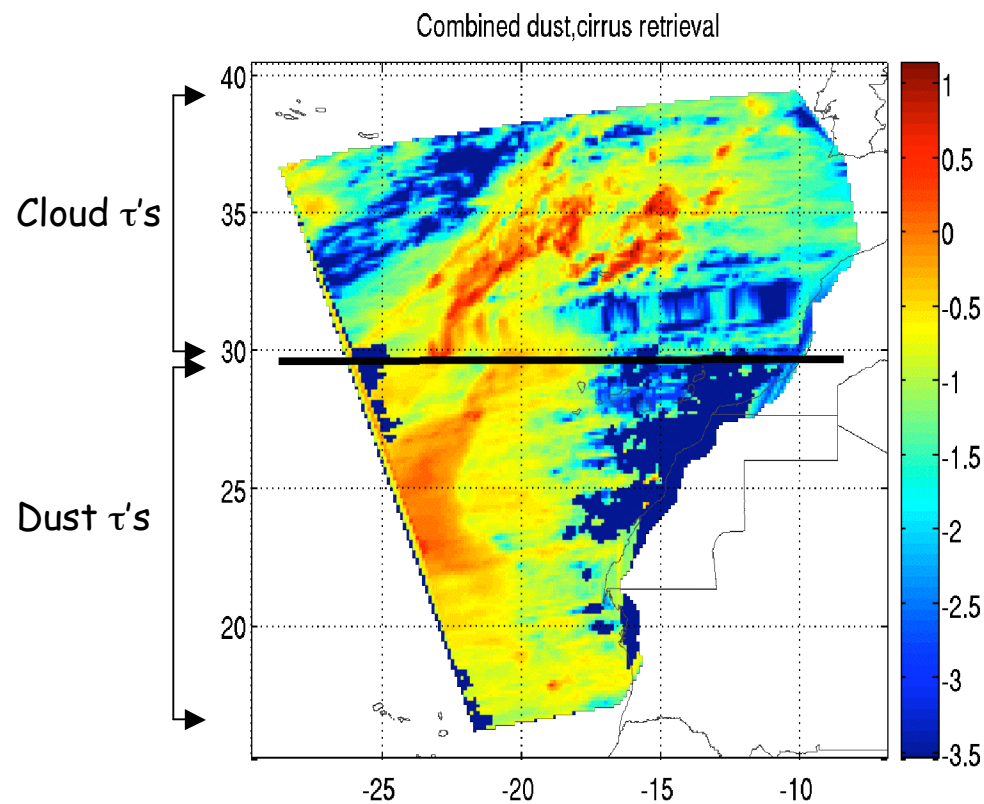
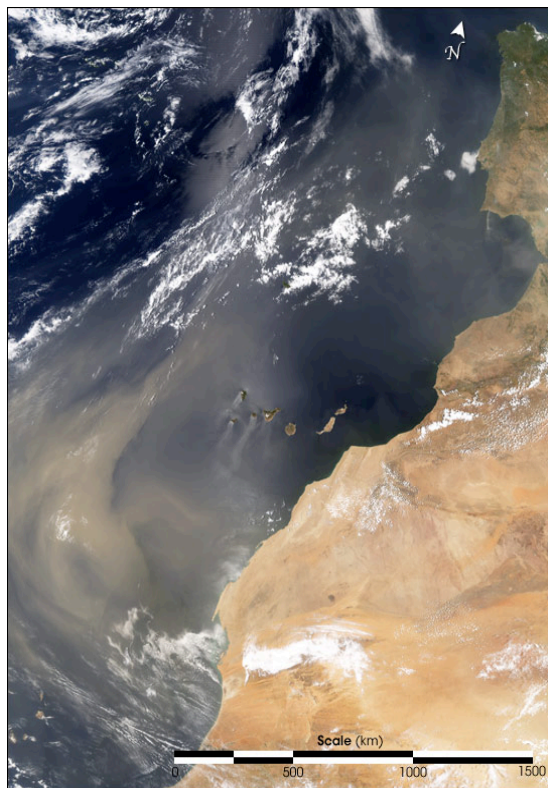
Cloud-Cleared Split Windows



Cirrus retrievals above line

Dust retrievals below line

Visible vs Derived Optical Depths



Conclusions

- We can minimize residuals due to dust
- Dust is impacting retrievals since it makes it though the cloud-clearing process *relatively* intact:
 - This is good news, in that we can then easily fit the dust to a model without having to deal with clouds.
 - This is bad news, the cloud-cleared radiances can be contaminated with dust
- So far, the Volz indices of refraction appear sufficient
- More work needed to evaluate capabilities when water/ice clouds are present.
- How determine placement of dust cloud? CO_2 slicing? A model (that is the TOMS approach for aerosol retrievals).
- Cirrus retrievals should have good sensitivity to thin cirrus, but handling simultaneous water clouds hasn't been worked out.